# A Study Of Various Devices Which Can Be Used To Immobilize Lobster Claws

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Fisheries and Marine Service

Industry Report 129

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# A STUDY OF VARIOUS DEVICES WHICH CAN BE USED TO IMMOBILIZE LOBSTER CLAWS

by

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## ABSTRACT

de Boer, H.D. and J.D. Castell. 1981. A Study of Various Devices which can be used to Immobilize Lobster Claws. Fish. Mar. Serv. Ind. Rep. 129: iii + 16p.

A study was initiated to investigate potential devices for lobster claw immobilization. The need for such an investigation was brought to light due to problems with the traditional methods. Wooden and plastic pegs enhance the spread of Gaffkemia, a lobster blood disease, and they blacken the meat around the thumb joints. Cut tendons also contribute to a high incidence of Gaffkemia. Rubber or elastic bands have been known to slip off the claws, and with time some types will deteriorate with salt water.

Small numbers of lobsters were used for experiments in the Department of Fisheries and Oceans, Canada, Halifax Laboratories, following which larger numbers of animals were banded with select devices at an experimental lobster culture station in Victoria, P.E.I. Further tests were later done in the field, on a lobster fishing boat, and in a live lobster shipping industry.

The conclusions here, put forward recommendations for devices to be used in immobilizing lobster claws, as well as work which needs to be done in the future.


Key words: Lobster, claw immobilization, pegging, banding, live storage, Gaffkemia.


## RÉSUMÉ

de Boer, H.D. and J.D. Castell. 1981. A Study of Various Devices which can be used to Immobolize Lobster Claws. Fish. Mar. Serv. Ind. Rep. 129: iii + 16p.

Une étude a été faite pour trouver des procédés qui permettraient d'immobiliser les pinces de homard. Le besoin d'une telle recherche s'est fait sentir à la suite de problèmes encontrés avec les méthodes traditionnelles. En effet les chevilles en bois ou en plastique contribuent à l'augmentation du "Gaffkemia", qui est une maladie du sang chez les homards et qui noircit la chair autour des joints du pouce de la pince. On s'est aussi aperçu que couper les tendons contribue à la propagation du "Gaffkemia".

De plus nous savons que les bandes en caoutchouc ou les élastiques glissent facilement de la pince, et que même certains se desagrègent au contact de l'eau salée.

Un petit nombre de homards ont été utilisés à titre d'expérience dans les "Laboratoires du Département des Pêches et Océans" à Halifax. Un nombre plus important de homards ont été bandés avec des instruments choisis, dans une ferme expérimentale pour homards, à Victoria dans l'Ile du Prince Edward.

D'autres tests ont été effectués sur un bateau de pêche, et aussi avec le concours d'une compagnie d'expédition de homards vivants.

La conclusion fait apparaître les lacunes qui existent quant aux procédés employés pour l'immobilisation des pinces de homards, et du travail qui reste à faire dans ce domaine à l'avenir.

## INTRODUCTION

Today, the lobster industry is a major economic factor in Atlantic Canada's total fishery. In 1980, the landed values for lobster on the Atlantic coast was over 73 million dollars (Canadian Fisheries - Primary Sector Activities, December, 1980). The value of fresh or frozen whole lobster exports in the same year came to over 74 million (Canadian Exports of Fishery Products, December, 1980). With these types of earnings, it is important to ensure that the product reaches the consumer in the best condition possible.

When live lobsters are stored or shipped in bulk, traditionally their claws are immobilized to keep them from injuring one another. If these animals were allowed free use of their claws while being stored in a lobster pound, it is estimated that losses due to cannibalism could be as great as 20% per week (Dobber, 1973).

In Europe, claw immobilization is done using twine or string (as in Denmark), or rubber bands (Prudden, 1962, McLeese and Wilder, 1964). However, wrapping twine or wire around individual claws is a slow process.

In Northern America, the tradition has been to insert wooden or plastic plugs in the thumb joints. This method is relatively easy, quick, and inexpensive. Despite all of these advantages however, problems have emerged as a result of using these plugs. Gaffkemia, a fatal blood disease, was found to spread quickly in groups of lobsters which were "pegged". It was soon discovered that the open wounds created by the plugs were an easy access for the invasion of Aerococcus viridans (var.) homari, the Gaffkemia pathogen (Stewart et al., 1975). At the height of an outbreak in a holding pound, Gaffkemia can cause 10% mortality per day ("Moving Lobsters", a film presentation of the Department of Fisheries and Oceans, Canada).

Today, live lobsters are shipped in bulk to various parts of the world. Europe, one of the biggest markets for live lobster, appears to be a dissatisfied customer. A good example to illustrate this is a report on the first known occurence of Gaffkemia in Norway. In this case, 500 lobsters were imported from the St. Lawrence area of Canada. During the first week in which these animals were held at the Norwegian pound, 23% had died. Assuming that the problem was a result of water pollution, the lobsters were moved to other facilities together with lobsters captured in Norwegian waters. During the following 6 weeks, the number of imported lobsters was reduced by about 60%. Wooden pegs had been used to immobilize claws on the Canadian lobsters while rubber bands were holding the claws shut in the Norwegian lobsters. The Gaffkemia pathogen was isolated from the dead animals and was also found at the tips of the pegs removed from five of the healthy Canadian lobsters tested (Hastein et al., 1977).

It is estimated that 10% of the lobsters in the live lobster industry die before they reach the consumer. This loss is the combined result of such factors as rough handling and Gaffkemia. ("Moving Lobsters", Department of Fisheries and Oceans, Canada.)

Another problem with the wooden and the plastic plugs, is that they cause a discoloration of the meat in the claws (Baird, 1950), and perhaps even an "off taste" in the meat (Wilder and McLeese, 1961).

The second method of claw immobilization which existed was cutting the extensor tendons, so that the lobsters were unable to open their claws. This again creates open wounds, allowing entrance to the Gaffkemia agent. As well, cutting tendons leaves the lobsters bleeding for a period of time which may or may not have adverse effects (Wilder and McLeese, 1961). To add to all of this, if a lobster with cut extensor tendons should have a claw opened accidently on contact with other lobsters, the animal is still capable of snapping it shut with full force (McLeese and Wilder, 1964).

At present, the most accepted method of immobilization is the application of rubber bands around the claws. In 1961, Wilder and McLeese published a comparative study of three methods of inactivating lobster claws. For their first experiment, 4 lots of 50 lobsters were held in three foot square tanks, with both claws plugged, banded, tendons cut and untreated. As shown in Fig.1, the untreated group suffered the greatest mortality rate, while the lobsters with their tendons cut had the second highest death rate. The plugged and banded animals had roughly equal survival rates. In a second experiment, groups of plugged and banded lobsters were exposed to the Gaffkemia pathogen, known at that time as Gaffkya homari. After merely 15 days, approximately 90% of the plugged lobsters died while roughly 50% of those banded were dead (Fig.2). Clearly, banding lobsters has advantages over the other treatments tested. It seems to impose less stress on the animals by not inflicting wounds to the claws, and thereby it reduces the incidence of Gaffkemia.

There are, however, still some problems which exist with the bands. Since their application is slow relative to the plugs, many Canadian fishermen object to using them (U.S. Department of Interior, 1961). In addition, the bands are not totally effective in claw immobilization. They may slip off, and often erode after prolonged periods of use (8 months) (Wilder and McLeese, 1961).

In view of these problems with traditional methods and bearing in mind the economic importance of our lobster industry, the project was designed to investigate alternative methods of immobilization of lobster claws. Since to date rubber bands are the most effective device, the goal was to find a device superior to these.

## PROJECT OBJECTIVES

In order to be acceptable a new claw immobilization device must satisfy certain criteria. First, the claws must be held shut for several months, since live lobsters are sometimes held for up to 6 months before they finally reach the consumer. Another requirement is that the device must not harm the lobster shell, or irritate any soft tissue, such as that which is exposed at the various joints. It is important that the device be manufactured of a material which is inert

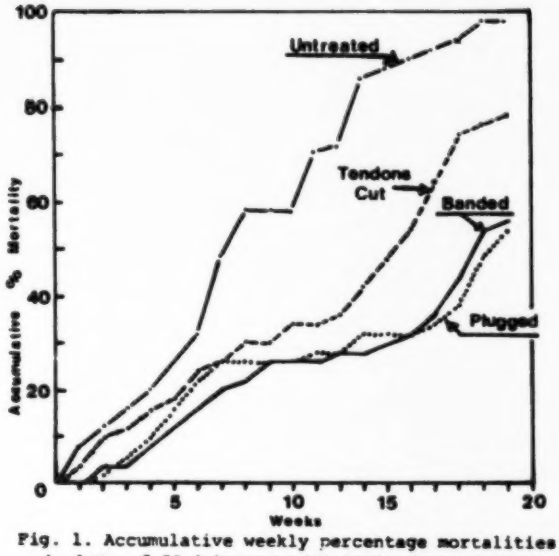



Fig. 1. Accumulative weekly percentage mortalities in lots of 50 lobsters with both claws plugged, banded, tendons cut and untreated.

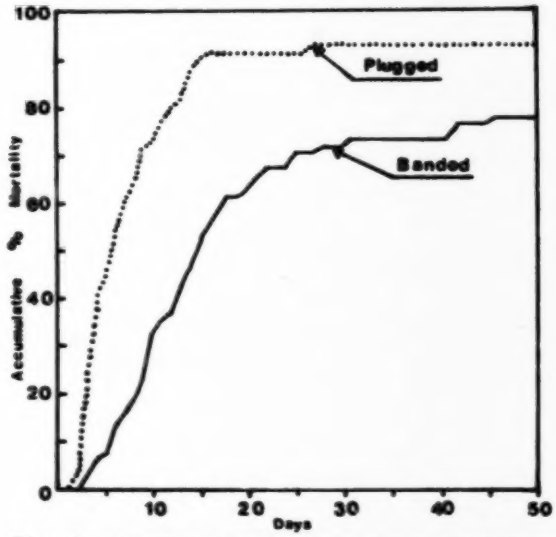



Fig. 2. Accumulative daily percentage mortalities among plugged (69) and banded (67) lobsters when exposed to Gaffkya homari.

in salt water. Also, the device must pass food and drug, fish inspection or other food regulatory standards for application to a future human food.

Should a device be successful in fulfilling the above requirements, it must also fulfill secondary considerations. It must be reasonably easy to apply by fishermen who would be using it out on a boat, in relatively rough weather conditions. The device must take a minimal amount of time to apply. Finally, the device must be available at an acceptable cost. This cost factor must also take into consideration any accessory equipment which may be necessary to apply the device onto the lobster claw.

## PREPARATION

First, a list of possible devices for claw immobilization was compiled. Telephone calls were made to various companies and businesses which might have something to offer. These included Dupont of Canada Ltd., fishing outfitters, rubber companies, electrical supply companies, plastic companies, and "3M", a manufacturer of adhesive tapes. A more detailed account of these telephone calls, and the specific company representatives which were contacted can be found in Appendix I of this report.

This search led to the following list of potential devices.

1) Black plastic cable tie wraps - manufactured by "Panduit"
2) White nylon cable tie wraps - manufactured by "Ideal"
3) White nylon cable tie wraps - manufactured by "Icorally"
4) White nylon cable tie wraps - manufactured by "AMP"
5) Heat shrinkable tape - manufactured by "AMP"
6) Wide plastic tape - manufactured by "3M"
7) Fiberglass reinforced tape - manufactured by "3M"
8) Vexar tubing - manufactured by "Dupont"
9) Grey elastic bands - manufactured by "Viceroy"
10) Yellow elastic bands - supplied by United Maritime Fishermen
11) Rubber tape (adhesive activates when stretched) manufactured by "3M"
12) "H" clips with elastic bands - clips manufactured by "Snowden Rubber"
13) Clear plastic - heat sealed around claw
14) Tissue cement
15) Vinyl electric insulation tape - made in Taiwan

All of the above possibilities are discussed in greater detail in Appendix II, Table 4.

Different testing experiments were set up, as more and more devices became available, and knowledge of the devices was gained. Initially, a small preliminary test was set up, involving 5 lobsters, and 4 different devices which were then available. After preliminary trials, a large supply of many devices was purchased in the Halifax-Dartmouth area. At this point in time, a small self-enclosed experimental room was prepared for use. Thirteen tanks were cleaned and iodophored. All tanks had degassers and ambient sea water was used. Once the experimental room was ready 130 stock lobsters were introduced, placing

10 in each of the 13 tanks. These lobsters were about one pound (average) in size and their claws had all been immobilized using single grey elastic bands.

After commencement of these experiments a trip was planned to a lobster culture pilot plant in Victoria, P.E.I. The goal here was to test the more promising devices on a large number of animals. Adequate supplies of the selected devices were purchased for this trip.

Later in this study, when more devices had been eliminated from the eligibility list, arrangements were made to test any remaining potential devices on a lobster fishing boat and also in the live lobster industry, specifically Clearwater Lobsters Ltd. A survey was prepared with the intention that it be included with live lobster shipments as they were sent overseas to Europe. Again, adequate supplies of any necessary devices needed for these field tests were obtained.

To take a different approach to the same problem of claw immobilization, a sample of deteriorated Viceroy rubber bands was obtained, (compliments of Ed Mason, Marine Lobster Farms Ltd., Victoria, P.E.I.) and sent to Viceroy Manufacturing Co. Ltd. in Montreal, along with a request for lab analysis of the sample in the Viceroy laboratories.

## FACILITIES AND EQUIPMENT

A separate experimental room was used in the Halifax Laboratory, containing 13 tanks, each measuring 39 inches x 39 inches x 13 inches deep Each tank was equipped with degassers, air stones, and drain protectors. Water temperature ranged from 3°C to 10°C.

The lobster culture station in Victoria, P.E.I. contained a large room with trays of individually held lobsters. Here, heated sea water was used (averaging about 16°C), in contrast to the ambient sea water used in the Halifax facilities.

## LOBSTER BANDING METHODS

### Methods of Application

Since the period of study here was limited, it was necessary to band the lobsters with the various devices at various dates, that is, as soon as the devices became available. Not all of the possible devices listed were tested fully, because they were not available early enough, and others were discarded as possibilities when it became apparent that they were not suitable. For example, tissue cement was not applied to the test animals, because it was an irreversible operation and also because it was felt that the consumer would not favour lobster claws which had been permanently glued together. As well, it is impractical for a fisherman in a boat at sea, to glue each of hundreds of claws together.

### Preliminary Experiment

Initially, as a few devices first became available, 5 lobsters held in a tank partitioned into 6 sections were banded, as well as another lobster which was available to use in a different tank. The first two devices to be tested were the wide plastic tape and the fiberglass reinforced tape. Both of these were introduced to us by a sales representative of 3M Canada Inc., (Tape and related Products Division). One lobster had each claw banded with the fiberglass reinforced tape. The tape was put on, carefully applying tape onto tape, making two complete tight wraps around each claw. One wrap was in front of the thumb spine, and the second wrap over the remaining lower spines in order to act as an anchor for the first wrap. Two other lobsters had their claws immobilized with the wide plastic tape, again using two complete tight wraps around each claw.

When the initial idea of using cable tie wraps was born, a small number of tie wraps were obtained from the maintenance staff in the Federal Fisheries and Oceans building. Two or more of the 5 preliminary test lobsters were banded using the cable tie wraps. For these animals, the positions of the tie wrap locks were alternated so that one lobster had the locks on the outer edge of the crusher claw and inner edge of the pincer claw, while the other lobster had the locks on the inner edge of the crusher and the outer edge of the pincer. (Refer to Fig. 5a in Appendix III for illustration of inside and outside edges of claw.) It should be noted here that these cable tie wraps, manufactured by Thomas and Betts, were not suitable for long term immobilization, since the locking mechanisms contained metal strips which would eventually corrode in salt water.

The last device to be used on the preliminary test lobsters was the heat shrinkable tape. One lobster was banded with this product, each claw having two complete continuous wraps.

### Main Experiment Done in Halifax

In the experimental room, the 10 lobsters of each tank were banded with the products shown in the diagrams or plans of this room (on the following page).

Figure 3. Diagram of Top Level Tanks in Halifax Experimental Room, and the specific tests done in each tank.

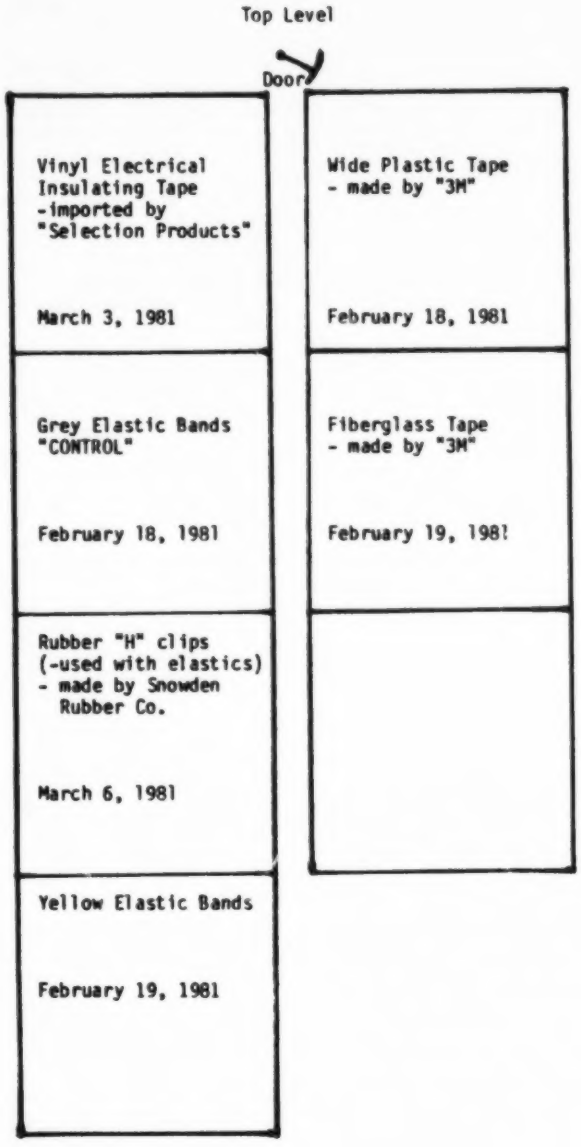
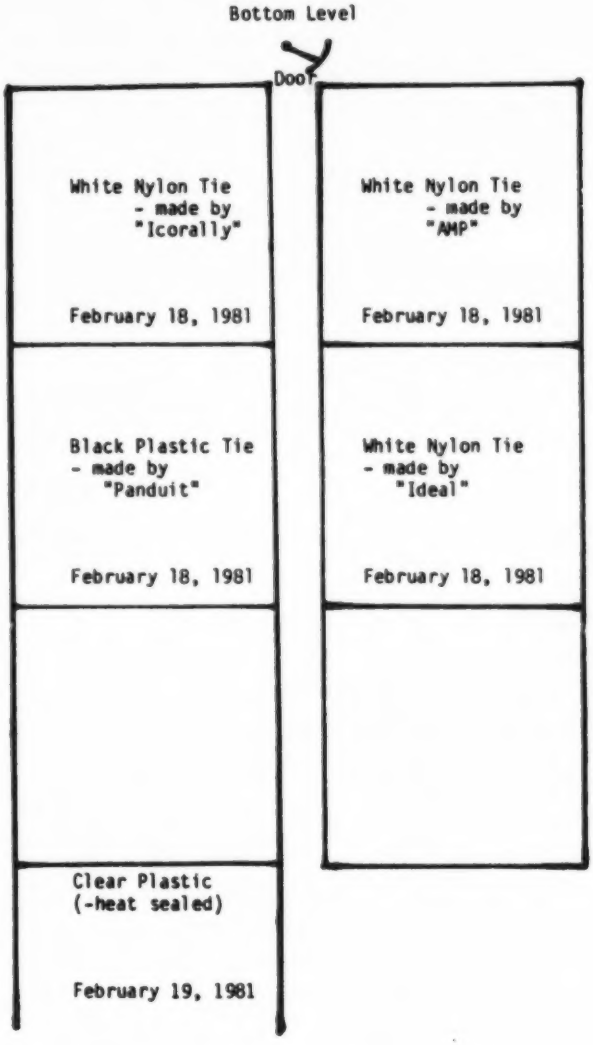

Top Level
Door
Vinyl Electrical Insulating Tape -imported by "Selection Products"
March 3, 1981
Wide Plastic Tape - made by "3M"
February 18, 1981
Grey Elastic Bands "CONTROL"
February 18, 1981
Fiberglass Tape - made by "3M"
February 19, 1981
Rubber "H" clips (-used with elastics) - made by Snowden Rubber Co.
March 6, 1981
Yellow Elastic Bands
February 19, 1981

Figure 4. Diagram of Bottom Level Tanks in Halifax Experimental Room, and the specific tests done in each tank.


Bottom Level
Door
White Nylon Tie - made by "Icorally"
February 18, 1981
White Nylon Tie - made by "AMP"
February 18, 1981
Black Plastic Tie - made by "Panduit"
February 18, 1981
White Nylon Tie - made by "Ideal"
February 18, 1981
Clear Plastic (-heat sealed)
February 19, 1981

All four of the cable tie wraps which were being tested were each applied so that half (5) of the lobsters had both of the locks on the inside edges of their claws, while the remaining 5 had the locks positioned on the outside edges of the claws.

For the tape products, manufactured by "3M", two complete tight wraps were made around each claw, just as was done in the preliminary experiments.

When the grey elastic bands and the yellow elastic bands were used, a single band was acting to restrain each claw.

Victoria, P.E.I. Lobster Farm Experiments

At the Prince Edward Island station, the four different cable tie wraps and "3M" tape products

were tested. The following table gives the exact numbers of lobster which were banded with each of the different products, and each of the various application methods:

Table 1. Methods of Banding Lobsters in Victoria, P.E.I.

| Product Tested | Total Lobsters Banded | Method of Banding |
|---|---|---|
| "Icorally" white nylon tie wraps | 35 | All 35 applied behind thumb spine |
| "Ideal" white nylon tie wraps | 29 | 15 behind thumb spine 14 in front of thumb spine |
| "Panduit" black plastic | 99 | 50 behind thumb spine |
| "AMP" white nylon tie wraps | 100 | 50 behind thumb spine 50 in front of thumb spine |
| "3M" wide plastic tape | 30 | |
| "3M" fiberglass reinforced tape | 30 | |

Additional Tests Done in Halifax

To further test the cable tie wraps, 30 lobsters (10 lobsters in each of 3 tanks) had their claws immobilized with cable tie wraps applied behind the thumb spines. "Panduit", "Icorally", and "AMP" tie wraps were tested, each type used to immobilize 10 lobsters.

Later on in the project, 43 canner sized lobsters (some with 2 claws, and some with only 1 claw) had their chelae (claws) immobilized using only the 3M plastic tape. Each lobster was kept in a separate compartment within a series of long trays.

Tests Done in the Field : A Lobster Fishing Boat

A trip was taken on a lobster fishing boat with a crew of 3, in order that a number of lobsters could have their claws immobilized with tape in a realistic situation. For this, the 3M plastic tape was used with the aid of a simple dispensor. Forty lobsters were caught ranging in size from canners through to a 5-6 pound lobster, and all of these had their claws taped shut. During this process, the fishing crew was questioned on what their opinion was of the tape, and what ideas they might have for an applicator.

Tests Done in the Field : Clearwater Lobsters Ltd.

At Clearwater Lobsters Ltd., Halifax, Nova Scotia, the "3M" plastic tape, the "3M" fiberglass reinforced tape, and the black vinyl electrical insulating tape was used to immobilize the claws on 40 lobsters each, putting the total number of taped lobsters here at 120. A copy of a survey sheet (Appendix IV) was intended to be placed in all shipments containing taped lobsters. It was intended that 5 taped lobsters be included with each shipment, the rest of the lobsters having their claws immobilized with elastic bands. Thus 24 surveys in total were to be sent out, each in separate shipments.

Extra Equipment Required

Many of the products which were tested here, were applied to the claws using extra equipment. This was done either out of necessity, or to make the application easier and less time consuming.

For the cable tie wraps, a tie wrap installing tool was used. This product is manufactured by Thomas and Betts Co. Such a tool requires that the tie wrap be pre-looped before the end tab is fed into the mouth of the installing tool. Then, the tie wrap is quickly tightened, and cut off at the lock by a half twist of the applicator.

Both the grey rubber and the yellow elastic bands were applied with the aid of band pliers. These special pliers enable the bands to be stretched wide open, and then placed over the claw. When the band is in the correct position, pressure on the pliers is released, and a quarter twist of the banding tool frees it completely from the band.

Clear plastic was used to encase the lobster claws. A bag sealer was used to seal off the open edges.

For the few trials with heat shrinkable tape, a curling iron was used as the heat source.

Finally, the "3M" tape products were applied with the help of a simple tape dispenser. This dispenser was only of assistance in allowing the tape to reel out freely, and the end of the tape to be quickly cut off.

## RESULTS TO DATE

Evaluation of Test Devices

Table 2 has been designed to clearly and concisely give pertinent information on the commercial products with which this project deals. Note that for both the ease of application, and the overall ratings, the most favourable score is 1 and the least favourable score is 10. These ratings are completely subjective, and may change should further testing be done.

Effectiveness in Immobilization

In order to thoroughly discuss the ability of the test products in keeping lobster claws closed, a table of the available test results from the major Halifax laboratory experiments is given (Table 3). A further addition to these results is then given, as each of the original possibilities is individually discussed in terms of its performance.

(1) "Panduit" black plastic cable tie wraps

Although these black plastic cable tie wraps initially appeared to be tight and secure around the claws, only 15% of the claws remained banded in Halifax after a period of 28 days. It should be noted that all 20 of the original tie wraps were applied onto the claw in front of the thumb spine, making it relatively easy for the ties to slip off.

Table 2. Evaluation Chart on Test Devices

| | Device | Cost per lobster (cents) | Timed per application (per claw) | Number of person used for timed application | Rating for ease of application | (Hfx. Lab) % claws remaining banded after: 4 wks. | 6 wks. | 4 mths. | Rating overall |
|---|---|---|---|---|---|---|---|---|---|
| 1. | "Panduit" tie wrap (placed in front of thumb spine) | 22, retail, small order | 30 sec. | 2 | 4 | 15 | 10 | 0 | 4 |
| 2. | "Ideal" tie wrap (placed in front of thumb spine) | 23, retail, small order | 30 sec. | 2 | 4 | 10 | 10 | 0 | 5 |
| 3. | "Icorally" tie wrap (placed in front of thumb spine) | 33.1, retail, small order | 30 sec. | 2 | 4 | 50 | 15 | 0 | 5 |
| 4. | "AMP" tie wrap (placed in front of thumb spine) | 4.86, retail, bulk order | 30 sec. | 2 | 4 | 60 | 30 | 0 | 4 |
| 5. | "AMP" heat shrink tape | 37.03, retail, small order | 240 sec. (estimate) | 1 | 10 | | | | 8 |
| 6. | "3M" wide plastic tape | 1.4, retail, bulk order | 90 sec. | 2 | 7 | 100 | 95 | 90 | 2 |
| 7. | "3M" fiber-glass tape | 2.42, retail, bulk order | 83 sec. | 2 | 7 | 100 | 100 | 95 | 1 |
| 8. | Vexar tubing | 0.0084 retail, small or bulk order | 25 sec. | 1 | 2 | | | | 4 |
| 9. | "Viceroy" grey elastic bands | 1.6, retail, bulk order | 21 sec. | 1 | 1 | 100 | 100 | 95 | 2 |
| 10. | Yellow elastic bands | | 21 sec. | 1 | 1 | 75 | 65 | 10 | 6 |
| 11. | "3M" rubber tape | 36.36, retail, small order | 120 sec. (estimate) | 1 | 7 | | | | 8 |
| 12. | Rubber "H" clips (used with elastics) | 12-14 (rubber) wholesale | 120 sec. (estimate) | 1 | 9 | 100 | 100 | 95 | 7 |
| 13. | Heat sealed plastic | | 240 sec. (estimate) | 1 | 10 | 85 | 85 | 55 | 7 |
| 14. | Tissue cement | | | | | | | | 10 |
| 15. | Vinyl elect. insulating tape | 2.65, retail, small order | 60 sec. (estimate) | 1 | 5 | 95 | 90 | 90 | 2 |

Table 3. Test Results of the Halifax Laboratory Experiment[7]

| Test Device | Total No. of days tested | Original No. of claws banded | Remaining No. of claws banded at end of test period | % banded claws remaining |
|---|---|---|---|---|
| "Panduit" tie wraps | 16 | 20 | 7 | 35 |
| "Ideal" tie wraps | 16 | 20 | 4 | 20 |
| "Icorally" tie wraps | 16 | 20 | 16 | 80 |
| "AMP" tie wraps | 16 | 20 | 14 | 70 |
| "3M" wide plastic tape | 16 | 20 | 20 | 100 |
| "3M" fiberglass tape | 15 | 20 | 20 | 100 |
| Clear plastic - heat sealed | 15 | 20 | 17 | 5 |
| Vinyl electrical insulating tape | 3 | 20 | 20 | 100 |
| Yellow elastic bands | 14 | 20 | 20 | 100 |
| Grey rubber bands (control) | 16 | 20 | 20 | 100 |

To test for the effectiveness of this spine in acting as an anchor for tie wraps, 50 lobsters were banded at P.E.I. with "Panduit" cable tie wraps placed behind the thumb spine, and 49 lobsters were banded with the same ties in front of the thumb spine. Here, 81% of the claws remained banded in the "behind spine" group, and 35% of the "in front of spine" group remained banded, over a two week period. When 10 lobsters in the Halifax laboratory had cable tie wraps placed around their claws, behind the thumb spines, 100% of the tie wraps stayed on over a period of 2 months. At the time that these "behind spine" lobsters were banded, two possible problems became apparent. One difficulty is that unless the tie wraps are applied extremely tight, the lobsters are able to open their claws slightly. Thus, there remains the chance that lobsters may injure each other. The second problem is that the area behind the thumb spine, the thumb joint, has exposed soft tissue. It is possible that the tie wraps will irritate this tissue, creating open wounds, and consequently a potential for rapid spread of Gaffkemia.

Note that although the two location sites for application of cable tie wraps, along with the problems associated with them, were discussed here under the brand "Panduit", these various points apply to all four brands of cable tie wraps which were tested in this project. Therefore, this discussion will not be repeated under the other three tie brands.

2) "Ideal" white nylon tie wraps

The "Ideal" products were not at all efficient as compared to the other three brands. After 28 days, only 10% of the claws remained banded, in the Halifax Laboratory. As well, the work done in P.E.I. revealed another problem. Approximately one out of every three ties applied using the tie wrap application tool, broke off at the locking device. When this happened, the loop was left broken, and a new pre-looped tie had to be applied; consequently, only 29 lobsters were banded in P.E.I. with the "Ideal" product, instead of 100, as was originally planned.

3) "Icorally" white nylon tie wraps

This brand of tie wrap gave good results in Halifax, relative to the other tie wrap brands. Here, 50% of the claws remained banded after a test period of 28 days. Unfortunately, the retail outlet had a shortage of "Icorally" tie wraps, and there were only 70 ties available for the P.E.I. tests. All of these were applied behind the thumb spines, and after 2 weeks, 87% of the claws remained banded.

In the Halifax laboratory, 100% of the tie wraps stayed on behind the thumb spines for the 10 lobsters being tested over a 2 month period.

4) "AMP" white nylon tie wraps

In Halifax, after testing for 28 days, 60% of the claws were still immobilized with "AMP" tie wraps. 100% of these tie wraps stayed on for 2 months when placed behind the thumb spines of 10 lobsters kept in Halifax. Within this test group, one claw actually was found severed from a lobster, suggesting that perhaps another lobster could have opened his claws enough to do such damage.

5) "AMP" heat shrinkable tape

Due to the awkwardness and time spent in applying this tape onto the lobster claws, with the aid of a curling iron, this product was not considered very feasible in terms of the project objectives. Thus, only 4 lobsters were banded in this fashion, one in the preliminary experiments, and three in the main Halifax laboratory room. Out of the 8 claws which were originally banded, one claw became free after just a few days. Testing on this product was terminated at that point.

6) "3M" wide plastic tape

This tape was 100% effective over an initial period of 4 weeks in immobilizing lobster claws in Halifax, both for the preliminary experiment and in the main laboratory. However, the staff at the Victoria, P.E.I. lobster farm recently reported that this type of tape was coming off some of their animals, (leaving 78% of the claws still banded after 2 weeks) possibly due to increased activity of the animals in heated sea water. For the 43 canner lobsters in Halifax which had their chelae immobilized with tape during the latter part of this project, 96% of the claws remained shut after a period of 1 month. This calculation was made for a total of only 39 lobsters, since 4 lobsters died upon initiation of the experiment. The deaths were not thought to be related to this taping experiment. Certain problems became apparent such as the possibility of increased incidence of shell rot on claws which were covered with this wide tape. However, when tape was removed from a number of lobster claws after 9 months of immobilization, there were no visual signs of shell rot. Also the application is time consuming and difficult, with or without a simple dispensor. The main reason for this difficulty is that the tape only sticks to itself, rather than to the claw, making the first wrap quite awkward.

Results of the field tests done on the lobster fishing boat simply involve the opinions of the crew. Their comments were that they felt that the tape could be a reasonable alternative to the rubber bands, provided that an inexpensive and durable machine was developed which could quickly and automatically apply tape around a lobster claw. They mentioned that a small spring-loaded machine which could be bolted onto the side of the boat might be the most suitable design. Such a machine is presently used at some bakeries to apply tape seals to bread bags.

7) "3M" fiberglass reinforced tape

Once again the "3M" fiberglass tape was 100% effective for 4 weeks in Halifax, but quite ineffective on the animals held at P.E.I. After 2 weeks, 63% remained banded. The fiberglass strands are shredding and coming apart from the rest of the tape. Shredding is considered a very major problem since the lobsters are eating the loose pieces of tape. Another problem was the same as that already mentioned for the wide "3M" tape, that is difficulty in applying the product.

8) "Dupont" vexar tubing

Vexar tubing might well hold lobster claws shut for shipping purposes but unfortunately, a small enough size was not available in time for long term tests. One pair of small tubes was made

from the larger sizes which were available, but after applying them on a lobster, the tube on the pincer claw came off within a day. Perhaps this was due to improper sizing or application of the makeshift device. Just recently, a smaller size of vexar tubing has become available for testing, but when applied to a crusher claw, the lobster could still open this claw.

9) "Viceroy" grey elastic bands

These bands were considered as the control device, since the search here is for a device which is superior to the elastic band. During the 28 day test, all 20 bands stayed on the claws, with no sign of deterioration. As mentioned in the introduction, the grey elastic bands are known to rot after a period of 8 months, and in less time, if they are used in heated sea water. There is a question as to whether these bands are 100% natural rubber, since they sink in salt water, and pure natural rubber should float. An elastic band manufactured from a cold salt water resistant material would be an improvement to the product which is presently available on the market.

10) Yellow elastic bands

The yellow elastics, which are also used by lobster fishermen, were supplied by United Maritime Fishermen in Moncton, New Brunswick. These bands were very inefficient in immobilizing lobster claws, since after just a few weeks, they would lose their elasticity and become brittle. When the bands came off of the claws, they would be found floating in the tank, stretched to the size of the claw which it had been applied to. Once these bands were removed from the water, they would shrink back to their original shape. If these bands were removed in a plastic bag full of cold sea water and brought into a warm room for observation, they would again shrink back to their original shape. This demonstrated that it was the low temperature, and not the salt water, which caused the yellow elastics to turn brittle and lose their elasticity. The suppliers of this product (U.M.F.) were informed of the problem, and they subsequently began to supply the "Viceroy" grey rubber bands as an alternative.

11) "3M" rubber tape with built-in adhesive

Four lobsters (8 claws) were banded with this product in the Halifax Laboratory, and approximately one hour later, 3 of the claws had already come free of the tape. Since the tapes had come undone (ie. they did not remain in a loop) it appears that the adhesive did not work well in salt water. Also, there were problems applying the tape initially, since a few times the tape did not stick to itself, and these claws had to be rebanded. Because of these difficulties, this type of tape did not look very promising for lobster claw immobilization, and therefore the testing of this product was discontinued.

12) Rubber "H" clips with elastic bands

"H" clips were 100% effective over a period of 4 months. However, it was noted that there was difficulty in opening the lobster claw and inserting the clip into a position close to the thumb joint. As well, wrapping a long elastic band around a clip is much more time consuming than simply applying a rubber band directly onto the claw. If this device was easier to apply it could possibly solve the problem of band slippage, but not that of band deterioration.

13) Plastic heat seals around claws

Plastic seals were 100% effective in restraining crusher claws and 70% effective for pincer claws, for the first 28 days during which they were tested. Pincer claws are more slender than crusher claws and therefore do not have a very good shape to which a plastic seal may anchor itself. To add to the problem, the time and extra equipment involved make this method an unlikely candidate for that chosen to be used by fishermen, in the same way it is not very feasible to use heat shrinkable tape.

14) Tissue cement

As already mentioned earlier, tissue cement was not formally tested, because its effects on lobster claws are permanent, and it is unlikely to be a reasonable method for fishermen to use out on the ocean, in their boats.

15) Vinyl electrical insulating tape

Vinyl tape has been 95% effective during the first 4 weeks which it was tested in the Halifax laboratory. When compared to the other tapes that have been tested, this one is relatively easy to apply, and its adhesive appears to be quite effective even when the tape is slightly wet.

Ease of Application

The ease of application of the test products has already been discussed to some extent, but further observations and comparisons may be made here.

Cable tie wraps in general were all quite easy to apply, if a tie wrap installing tool was used with pre-looped ties, on a two person operation. One person alone can apply the tie wraps as well, but since the individual here was inexperienced, the task of applying the ties became much more difficult.

Tapes are difficult to apply, especially when attempting to stick tape on tape with the first wrap. If these types of products are going to be feasible, a good applicator must be developed which will automatically make the seal on the first wrap, and be usable on a fishing boat by one man.

Rubber or elastic bands are relatively easy to apply with the use of band pliers.

Time Factors Involved in Application

The time involved in applying a device is very closely related to how easy the device is to apply. However, time is a much easier parameter to measure. When lobsters were banded at the P.E.I. lobster farm, approximate times were obtained for the different immobilization methods. In each case, a two person operation was used. Cable tie wraps averaged 3 seconds each to apply. The "3M" wide plastic tape took 1½ minutes on the average for each claw. For the fiberglass reinforced tape, the average time was slightly less, at 1 minute and 23 seconds each.

Rubber or elastic bands are relatively quick to apply with the use of band pliers. For one inexperienced bander, it took an average of 21 seconds for each application (per claw).

The devices appearing to require the most time in application are the "H" clips used with elastic bands, the heat shrinkable tape, and the heat sealed plastic.

## COMMERCIAL ECONOMIC VIABILITY

As seen in Table 2 under results, many of the test devices are relatively expensive when only small quantities are to be purchased. "AMP" made available a price list for various numbers of the tie wraps which could be purchased. Here, the cost to the consumer ranges from $6.93 per 100 tie wraps, when the total order is for 100, all the way to $24.26 per 1,000 tie wraps, when the total order is for 1,000,000. In other words, in small amounts, the "AMP" cable tie wraps cost close to 7¢ each, but with a very large order, the same product is available at 2.4¢ each, (4.8¢ per lobster). Other tie wrap manufacturers did not have similar information available at the time that this report was written, since their prices are said to be negotiable only when large quantities are purchased.

Vexar plastic netting, manufactured by Dupont Canada Inc., is available at a cost of .042¢ per metre for both large and small orders. If 10 cm. of Vexar tubing were used for each claw, then the cost would be 0.0084¢ per lobster, making this by far the least expensive of all of the devices considered in this project.

The "3M" wide plastic tape is available at a cost of 1.4¢ per lobster, when a large quantity is ordered. This price is on tape which has been reduced from a 1 3/4 inch width, to a 1 inch width. For a bulk order of 1 inch width 3M fiberglass tape, the cost per lobster is 2.42¢. The first price quoted may be favourably compared to that quoted by Schooner Outfitting, for a bulk order of ½ inch by 1 inch "Viceroy" grey elastic bands. Here, the cost comes to 1.6¢ per lobster. Another reasonable cost estimate is the vinyl electrical insulating tape, coming to 2.65¢ per lobster. Note that this price was calculated from the retail cost of one roll, and not from a bulk order price list. All of the above costs for the tapes are based on 12 inch lengths of tape applied onto each claw. Therefore, with less tape used per application, these costs may be reduced further.

## CONCLUSIONS TO DATE

At this point in time, it appears that the "Viceroy" grey elastic bands are the best type of device for immobilizing lobster claws. They are available at a reasonable cost, and they normally do not cause any injury to lobsters.

As yet, there is no easy and quick method for applying tape to lobster chelae. Therefore, the tapes cannot be recommended for use at this time. Should an efficient applicator be developed in the future, there would be a number of advantages in using tape. The "3M" plastic tape has been shown to be less expensive to use than the "Viceroy" elastic bands. It is possible to manufacture this particular tape with printed words ingrained into the material, making the plastic tape valuable for identification and advertising purposes. With a proper applicator, tape may prove even faster to apply to lobster claws than elastic bands are at present. Fiberglass reinforced tape, also manufactured by "3M", works well, but is unfavourable due to its higher price. Black vinyl electrical insulating tape works well and is reasonably priced. However, it may or may not have the added advantage of being able to be produced with printed words ingrained into the material.

Vexar tubing does not immobolize lobster claws sufficiently if applied in a direct and simple manner. However, if a method was somehow devised through which lobster claws could be held tightly shut using Vexar plastic netting, it would certainly merit further consideration, due to its low cost.

It appears that all of the other devices considered in this study, cable tie wraps, neat shrink tape, rubber tape, yellow elastic bands, rubber "H" clips, heat sealed plastic, and tissue cement, may be eliminated as potential devices for lobster claw immobilization. These products are unsuitable for various reasons, including high costs, lengthy application times, difficult application procedures, and incapability of keeping lobster claws tightly closed.

## RECOMMENDATIONS FOR FUTURE WORK

Although this study has involved a number of different screening processes, and subsequent testing in the field, there is still room for further research to be done in this area. The following study proposals may produce a more efficient method for immobolizing lobster claws than the one that is presently recommended in this report.

### Study Proposals

1) Investigate the possibility of manufacturing elastic bands using more marine water resistant materials than those used at present. Such an investigation was initiated in a letter written to Viceroy Manufacturing Co. Ltd., but no response had been received at the time during which this report was written.

2) Develop an efficient tape applicator for the purpose of immobilizing lobster claws. Presently there are a few groups or individuals which have been contacted and are to some degree working on plans for a prototype. These people are:

   a) Jean M. Beauregard
   3M Canada Inc.
   680 Lépine Avenue
   Dorval, Quebec
   H9P 1G2
   Tel: 514-631-7600

b) Bob Bassett
Support Services
Dept. of Fisheries and Oceans
Fisheries & Environmental Sciences Division
Halifax Laboratory
P.O. Box 550, Halifax, N.S. B3J 2S7
Tel.: 426-6205

c) Mr. John Merrit
Technical University of Nova Scotia
(formerly Nova Scotia Technical College)
Tel. : 429-8300 Ext. 325

d) Mr. Patrick Taiani
Tel.: 424-8673
and
Mr. John Campbell
Tel. : 424-8670 Ext. 186
Nova Scotia Research Foundation Corp.

3) Distribute surveys in the field to gather opinions of concerned individuals and groups with respect to tape and tape applicators. Some surveys have already been sent to overseas customers of Clearwater Lobsters Ltd., but due to a mail strike shortly after their distribution, results have been delayed. In future, large numbers of surveys should be distributed to lobster fishermen and consumers of lobsters.

## ACKNOWLEDGEMENTS

We would like to thank our co-workers in Halifax, Miss Nancy Kay, Miss Karen Rogers, Mr. Ron Stewart, Mr. David McCaan, Miss Louise Desjardins and Ms. Joan Kean, for helping us on numerous occasions with our laboratory work. As well, we are grateful for the assistance that Joan Kean gave us in the banding trials done in Prince Edward Island, the taping done on the lobster fishing boat, and in reviewing this report. Many thanks to the staff in the Halifax wet lab, Mr. D.J. Cassavechia, Mr. Fred Rahey and Mr. Jim McNeil, for their assistance and concern for our experimental animals. Mr. Ed Mason and his staff were valuable aids when we visited their experimental lobster culture station at Victoria, Prince Edward Island. Our appreciation is also directed toward Mr. Bob MacDonald and his staff at Clearwater Lobsters Ltd., and Mr. Ted Anderson and his lobster fishing crew at East Peptpeswick, Nova Scotia, for their help in the field. We are grateful to Mrs. Diane Stewart, Ms. Anne Power and Miss Coleen Holman for their support in typing this report. As well, Mr. Henri Medina's assistance in translating the abstact of this report into French was greatly appreciated.

Finally, our special thanks go to Dr. J.E. Stewart, who provided funds for this project, and offered his continued support throughout.

## APPENDIX I

The following is a list of all possible devices known up to,this point, which were tested to immobilize lobster claws. Included in this list where possible is the manufacturer of the product and/or the place where the product was purchased. Also mentioned are the names of any personal contacts which were made in each case.

1) Black plastic cable tie wraps
   - manufactured by "Panduit"
   - purchased at Anixter Turmac, 100 Wright Avenue, Dartmouth, N.S.
   - personal contact: Frank Higgins

2) White nylon cable tie wraps
   - manufactured by "Ideal"
     - Ideal Industries Inc., Sycamore, Ill. U.S.A.
       In Canada: IDI Electric (Canada) Ltd., Ajax, Ontario
   - purchased at Lightland Limited, 617 Windmill Road Dartmouth, N.S.

3) White nylon cable tie wraps
   - manufactured by "Icorally"
   - purchased at Fulton R.L. Equipment Ltd., 5654 Russel St., Halifax, N.S

4) White nylon cable tie wraps
   - manufactured by "AMP"
     - AMP of Canada Limited (made in U.S.A.)
   - purchased at AMP of Canada Limited, 10 Akerley Blvd., Dartmouth, N.S.

5) Heat shrinkable tape
   - manufactured by "AMP", AMP of Canada Limited
   - purchased at AMP of Canada Limited, 10 Akerley Blvd., Dartmouth, N.S.

6) Wide plastic tape
   - manufactured by 3M Canada Inc., 6100 Young Street, Halifax, N.S.
   - obtained from 3M Canada Inc., 6100 Young Street, Halifax, N.S.
   - personal contacts:
     - Gord Couglan (sales rep.)
     - Jean M. Beauregard (district sales manager)

7) Fiberglass reinforced tape
   - manufactured by 3M Canada Inc. (same as plastic tape above)

8) Vexar tubing
   - manufactured by Dupont Canada Inc., Box 2200, Streetsville Postal Stn., Mississauga, Ontario
   - obtained from Dupont Canada Inc. (same as above)
   - local distributor
     - Coastal Industrial Sales Co. Ltd., 100 Wright Avenue, Dartmouth, N.S.
   - personal contact: A. Sura (Manager - "Vexar" Plastic Netting, Packaging Div.)

9) Grey rubber bands
   - manufactured by
     Viceroy Manufacturing Co. Ltd.,
     2 Churchill, "C" Mart, C.P. 1346,
     Montreal, Quebec H5A 1H2
   - purchased at Schooner Outfitting,
     6359 Bayne Street, Halifax, N.S.
   - personal contact: Mr. Pierre P. Gayne
     (Viceroy Manufacturing Co. Ltd.)

10) Yellow elastic bands
   - purchased from United Maritime Fishermen,
     254 Baig Blvd., Moncton, N.B. E1E 1C8
   - personal contact: Mr. Owen Walton
     (United Maritime Fishermen)

11) Rubber strips with built-in adhesive
   - available from Snowden Rubber Indust. Ltd.,
     902 Windmill Road, Dartmouth, N.S.
   - personal contact: Bruce Moore

12) "H" clips with elastic bands
   - manufactured by Snowden Rubber Indust. Ltd.,
     (same as above)

13) Plastic heat sealed around claw
   (No further information available now)

14) Tissue cement
   (No further information available now)

15) Vinyl Electrical Insulating Tape
   - made in Taiwan

Extra

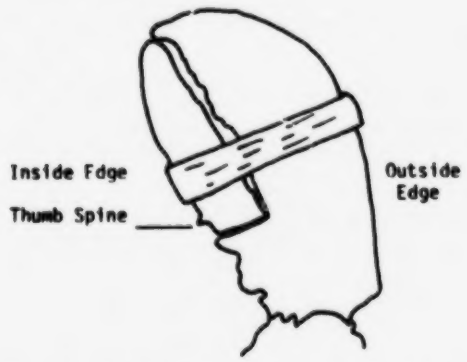
- Cable tie wrap installing tool
   - manufactured by Thomas & Betts Co.,
     Construction & Maintenance,
     920 Route 202, Raritan,
     New Jersey 08869, U.S.A.
     in Canada - Thomas & Betts Ltd.,
     Iberville, P.Q.
   - purchased at Wesco - Westinghouse,
     3377 Kempt Road, Halifax, N.S.
   - also available at Anixter-Turmac,
     100 Wright Avenue, Dartmouth, N.S.

APPENDIX II. Table 4. Information Chart on Test Devices

| Device | Manufactured By | Purchased at or Obtained From | Description | Dimensions | Catalog Number | Strength | Common Uses | Extra Equipment Necessary to Apply |
|---|---|---|---|---|---|---|---|---|
| 1. Cable Tie Wrap | Panduit | Anixter-Turmac | black, plastic | 11 1/2"long | PL3TS | 30 lbs (minimum tensil strength) | wrap electrical cables or wires together in a bundle | tie wrap installing tool |
| 2. Cable Tie Wrap | Ideal Ind. Ltd. | Lightland Ltd. | white,nylon | 11 1/4"long | 41-839 | 30 lbs (min.t.s) | " | " |
| 3. Cable Tie Wrap | Icorally | Fulton R.L. Equip. Ltd. | white,nylon | 11" long | 3180 | | " | " |
| 4. Cable Tie Wrap | "AMP" of Canada Ltd. | AMP of Canada Ltd. | white,nylon | 7 3/4" long | 80305 | 50 lbs | " | " |
| 5. Heat Shrink - able Tape | AMP OF Canada Ltd. | AMP of Canada Ltd. | | 58 1/2'/roll 1/2"wide | 52623 | | sealing or repairing continuous cable lines | curling iron |
| 6. Wide Plastic Tape | 3M Canada Inc. | 3M Canada Inc. | Polyester, with a rubber based adhesive | 216'/roll 1 3/4" wide | 3M#352 | | packing, freezer tape | tape dispenser |
| 7. Fiberglass Reinforced Tape | 3M Canada Inc. | 3M Canada Inc. | " | 180'/roll 1/2"wide | 3M#898 | | packing tape, especially when strength is needed | tape dispenser |
| 8. Vexar Tubing | Dupont Canada Inc. | Dupont Canada Inc. | brown | | H-103 | | onion bags, turkey bags - curlers | |
| 9. Grey Elastic Bands | Viceroy Man. Co. Ltd. | Schooner Outfitting | | 1"x 1/2" | | | | band pliers |
| 10. Yellow Elastic Bands | | UNF, Moncton N.B. | | 1"x 1/2" | | | | band pliers |
| 11. Rubber Tape with built-in adhesive | 3M Canada Inc. | Snowden Rubber Ind. Ltd. | adhesive activates when tape is stretched | 33'/roll 3/4"wide | | | | |
| 12. Rubber "H" Clips (to be used with elastic bands.) | Snowden Rubber Ind. Ltd. | Snowden Rubber Ind. Ltd. | | | | | | |
| 13. Heat Sealed Plastic | | | | | | | | plastic bag sealer |
| 14. Tissue Cement | | | | | | | | |
| 15. Vinyl Electrical Insulating Tape | -made in Taiwan -imported by Selectum | Woolco | | 20 meter roll 3/4"wide | 31-333 or LR32836 | | Insulate electrical wires | |

APPENDIX III

Figure 5. Lobster claws immobilized using various devices.




5 a) Rubber or elastic bands applied in front of thumb spine.

5. b) Wooden or plastic peg pushed into thumb joint.

(i)

(ii)

(iii)

5 c) Cable tie wraps applied with:

(i) lock device on inside, in front of thumb spine.

(ii) lock device on outside, in front of thumb spine.

(iii) lock device on outside, behind thumb spine.

5 d) "3M" wide plastic tape.

5 e) "3M" fiberglass reinforced tape

5 f) Vexar tubing.

5 g) Rubber "H" clip used with elastic band.

APPENDIX IV

Letter and Questionnaire used at Clearwater Lobsters Ltd.

Dear Customer:

Clearwater Lobsters Ltd. is participating in a government sponsored program to improve lobster claw immobilization techniques in Canada. This program is an attempt to reduce diseased lobsters as well as to provide a better product. Some of the lobsters which you have just received should have their claws immobilized with tape. This particular product has so far proved to be comparable to or better than the elastic band for keeping lobster claws shut in our laboratories. We would appreciate your feedback and comments in answering the following short questionnaire.

Sincerely,

Heidi de Boer
(Federal Government Consultant)

Questionnaire

1. The date on which the lobster shipment was received was _____.

2. The type of tape in my shipment which was used to keep some of the lobster claws shut was (check answer)

   a) tan coloured plastic tape ( )
   b) fiberglass reinforced tape ( )
   c) black vinyl tape ( )

3. I feel that the tape is a (check answer)

   better ( )
   equal to ( )
   worse ( )

   product than the elastic band in keeping lobster claws shut.

   The reason(s) for this is (are):

   _____

   _____

   _____

   _____

   _____

Additional Comments: _____

_____

_____

_____

_____

My address is: _____

_____

_____

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